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ABSTRACT

Ways children learn are described and related to aerospace education. Discussion focuses on (1) providing activities on the child's level of understanding; (2) considering the whole child; (3) stimulating curiosity; (4) encouraging thinking; (5) presenting varied experiences; and (6) integrating curriculum areas in each learning activity. Ideas presented are intended to serve as a springboard for educators to investigate more deeply theories behind the ways children learn. (RH)

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AEROSPACE EDUCATION: HOW CHILDREN LEARN

Dr. Glenda F. Roberson

Introduction:

The importance of children participating in and learning about aeorspace and aviation can not be over emphasized. Today's children will be the leaders for space related programs in two or three decades. Many of the children currently in elementary school will choose to devote a career to this endeavor. As a teacher of children, one has a responsibility toward building a foundation of concept understanding and affective learning concerning aerospace.

A comprehensive, well-grounded understanding by the teacher of how children learn is complimentary to the child's learning aerospace education. Some components for effective learning will be discussed.

Providing Activities on the Child's Level as a Component in Learning

Providing experiences on the child's level of understanding is perhaps one of the most difficult tasks educators face. No one has done more to influence this area of education than Jean Piaget. Not an educator, but a Swiss epistemologist, his findings have resulted in cognitive levels of development. A child does not skip levels, but rather moves sequentially through each stage as he intellectually develops. One stage, therefore, builds on the preceding cognitive stage. It is very important that the child is provided experiences on his level of cognition. Tasks should not be so difficult that the child loses interest, nor so easy the child becomes bored.

Chart I: Piagetian Cognitive Stages

Cognitive Level	Approximate Age
Sensory Motor	birth - 2 years
Pre-operational	2 - 7 years
Concrete operational	7 - 11 years
Abstract	11 + years

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Piaget has developed cognitive stages for all ages. Only the concrete operational stage of cognitive development will be discussed at this time. This state begins usually around the age of 7, but it should be pointed out that all stages begin at varying ages and progress from simple to a more complex level with time and experiences. Characteristics of this stage may be observed earlier or later than age 7, depending on the individual child. Gradually over a period of approximately four years, observable advancement in intelligence can be noted. A very simplified description of the concrete operational stage follows:

> The child has the ability to mentally reverse actions performed in the environment; thus, the child is capable of moving beyond the stage of mere perceptual appearances (Forman and Kuschner, 1983). This ability to reverse thinking applies to concrete situation, not to hypothetical situations.

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The teaching significance of this characteristic of elementary age children for educators in aerospace may include: Mathematical computations, such as adding and subtracting, are best understood if actual objects are used. The child, in physically arranging objects into sets, is able to visually understand the parts that go to make up wholes.

The child is not yet capable of using logic to solve problems which are not concrete. Hypothetical and complex verbal problems are beyond this level of thinking. Thinking again must be tied to the concrete, especially when the child moves into this level of thinking (Salkind, 1985). Fewer concrete objects are needed, of course at the end of this level.

A teacher of aerospace education should keep in mind this level of thinking requires the use of many concrete objects from which the child learns. It is through manipulating these "hands on" materials that sense is made of concepts. Concepts about different types of clouds will not be learned through long verbal explanations. The concepts could more easily be understood through activities such as classification, or matching, of picture cards depicting the different cloud formations. Learning activities based on bingo methods and maze games such as those using monopoly ideas can easily be constructed by educators to be used by students to learn concepts.

The child is capable of conservation. Conservation is the ability to mentally maintain the equivalence between two objects, even though one dimension of the object undergoes some change. (Dennis, Gruber, Norwood, and Short, 1983)

Educators in aerospace concepts should be cognizant of the child's ability to understand changes in matter. Experiments in science allow the child to actually participate in such events as converting water into ice and predicting the future effects of different temperatures on the frozen matter. Also, the child, in predicting change is capable of leaning expanding and contracting states of matter and can predict the changes in the amount of space either matter requires. Again, these kinds of concepts are best understood through actual participation in the changes, not in hearing about them.

Considering the Whold Child as a Component in Learning

It should be pointed out that cognitive growth is only one area of a child's development. Other areas, just as important, include:

Social Development

This age child is moving from egocentric to sociocentric thinking. Piaget (Salkind, 1985) describes this change in terms of

the child's awareness that others have a perspective on the world that may be different than his own. Working with others is important at this time.

Team endeavors require cooperation, responsibility, communications, respect for others, sharing, and other such social skills complimentary to group living. Constructing a kite and trying it out with a partner offers the child such experiences. Participating in a class play encourages social skill development.

Moral and emotional development

Affective learning may involve viewpoints, appreciation and the individual's feelings about different happenings. Morals and values can stem from these thoughts. Children benefit in sharing feelings about sunsets, sunrises, rainbows, waterfalls, rainy days, snowflakes, and other environmental factors. Talking and writing about such topics helps to crystalize thoughts. Many excellent library books are available that can either be read to the child, or read by the child, and learning through literature should be encouraged.

Physical development

Children normally are energetic and can not be expected to remain passive for long periods of time. Physical activity promotes overall health and vigor. Seatbound children become restless. Moving to different places in the room to work on projects is helpful. Aerospace activities which can productively channel energy may include creative dramatics and role playing activities.

Stimulating Curiosity as a Component in Learning

All children are normally curious and spend a great deal of their time investigating, manipulating, inspecting, and asking questions. Many theorists believe these activities provide the foundations for more complex behaviors that appear later such as reasoning, problem solving, and social competence. Research studies (Bradbard and Ensley, 1980) show that the curiosity of the child can be fostered by adults who show to the child attentiveness, sensitivity, and support. The classroom teacher's role, therefore, in fostering and developing curiosity in students is essential. The teacher must serve as the facilitator of curiosity. Teachers can encourage curiosity in the child's learning about aerospace through the following techniques:

Asking relevant questions

Adults may successfully keep a child's interest by asking key questions during the learning process. "Can you tell me about the atmosphere?" "Where is it?" "What is it made of?" "Can you think

of two words to describe it?" These kinds of questions stimulate a child's interest and gives direction to a study pertaining to the atmosphere.

Providing novel materials for the student to work with

Research (Hutt, 1970; Nunnally and Lemond, 1973) shows students demonstrate more curiosity in learning if the materials provided are novel rather than traditionally familiar to the child. If the goal of the lesson on rocket propulsion utilizes model rockets, students are likely to be more motivated to learn the concept than if merely reading about it.

Serving as an appropriate role model for the child

Children need role models to imitate. Adults must demonstrate their curiosity to the child and show ways of problem-solving. Teachers of aerospace education do not have to know all the answers. If the teacher can not recall the mission of the Challenger space launch, modeling to the child the method of finding out is valuable to the child. Educators can serve as positive role models in the area of current events by bringing in newspapers articles about the space program and developing lessons utilizing them.

Maintaining appropriate group sizes for learning

Curiosity may decrease if the number of children participating is too large (Endsley and Gupta, 1978). Many aerospace activities are more effectively used in the classroom in small groups or on an individual basis. In learning about the aerospace environment, weather experiments such as cloud formation experiments are best carried out in small groups. An individual student may demonstrate a great deal of interest in space vehicles and should be encouraged to pursue this area further.

Encouraging Thinking as a Component in Learning

A major goal in any educational activity must be the developing of the child's thinking skills. Wasserman (1977) pointed out that teachers may encourage, as well as discourage children's skills in thinking. If indeed, educators are committed to encouraging the child to think, the following teacher responses to the learner should be considered:

Ask for the pupil's ideas, opinions, and points of view. Example: "Jamie, based on the different ideas we have discussed about the origin of the universe, what is your belief?" This type of response requires the learner to accept responsibility for his ideas.

Ask the child to clarify what he is saying. Example: "Tell me more about why clouds form." This type of verbal mirroring allows the child additional direction in reflecting on an idea.

Ask questions to promote additional inquiry. Example: "What do you think you would do in severe weather such as a hurricane?" This type of encouragement allows the child further experiences in learning about aviation weather.

Ask divergent rather than convergent question. Convergent questions require low level thinking responses such as yes or no. Divergent questions illicits responses from the student demonstrative of thinking based on the knowledge available. Often the question may have more than one correct response. "Can you describe Haley's comet?" requires the mental recall of everything the student has learned about the comet and his answers may vary from those another student recalls. Both children's responses could be correct, however.

Well-meaning teachers too often discourage thinking skills unknowingly. The following responses by the teacher inhibits thinking:

Offering inappropriate verbal responses "That's right." "Very good." Verbal rewards of this type often terminate thought processes prematurely. No response from the teacher may indicate to the child to continue with his ideas more thoroughly in the area of interplanetary space.

Restricing thinking time after asking the child a question

Inadequate time to formulate ideas and to answer them, discourages the child's thinking in such areas as map skill exercises. After asking the child to locate on the map Cape Kennedy, sufficient time should be allotted for the child to actually complete his search for it. Too often, teachers ask questions and the brighter two or three children in the classroom are allowed to anwer while the remaining students continue to search for the answer. Soon these slower students learn they will not be allowed sufficient time and give up even trying.

Telling or showing the pupil what to do beyond the basic general instructions

Statements by the teacher such as "Here, let me show you the planet's positions in space" discourages the child's thinking. The child possibly could think through this activity without being shown by the teacher and should be given the opportunity.

Presenting Varied Experiences as a Component in Learning

Basic to the child becoming adept in reading, writing, and computing skills, experiences in a variety of activities are desirable. Aerospace education provides a catalyst for such development.

Visual discrimination skills

Aerospace educational learning experiences that require the adeptness of one's eyes may include:

- working puzzles
- block building
- comparisons involving likenesses and differences
- sequencing
- film and film strip viewing
- space games
- card games

Identification of astronauts from pictures involves discrimination in vision.

Auditory discrimination skills

These skills may vary widely to include listening activities such as following:

- songs and music
- stories read aloud
- poems read aloud
- choral readings

A game involving the many different sounds of weather requires discriminate listening. The child can distinquish sounds of raindrops beating down, gentle breezes, fierce twisters, snow floating softly to earth, and thunderstorms with great quantities of electricity.

Eye-hand coordination activities

These activities involve the eyes and hands working together. Such activities include:

- cut and paste experiences with paper
- tracing, drawing
- coloring, finger painting
- writing
- science experimentation
- woodworking
- model construction
- sewing activities

Participating in the construction of a mural about a rocket launch could include many of these coordination skills. Designing, cutting out, and sewing a flag for the moon could be beneficial.

Fine motor skill development

Hand and finger muscle development is attained through experience in:

- model assembling
- paper activities that involve cutting, pasting, tearing, and folding
- clay formations
- puppetry
- cooking experiences
- grasping and holding objects
- tempora painting

Building a diaroma of the planets may incorporate such motor skills. Constructing shadow boxes of imaginary space animals could be fun and creative

Gross motor skill development

Making one's body do as one so desires requires experiences in creative activities such as:

- movement and drama
- running, bending, reaching
- stretching, crouching
- skipping, hopping, and crawling
- swinging, swaying

Imitating a "pretend space creature" can be fun as well as developmental.

Integrating Curriculum as a Component in Learning

Children are not as capable of learning segmented curriculum as is the adolescent. Therefore, it is essential that the curriculum be integrated as much as possible. A single aerospace activity may include math, science, geography, social science, reading, spelling, vocabulary, writing, economics, as well as other additional subjects. This can be a very positive learning experience for the child.

Example: The topic of food and nutrition for the astronaut may involve learning:

mathematics - amounts, volume, sizes, fractional parts, and graphs

science - nutrients, food processing, gravity, and Newton's Law

geography - map skills showing the source of the food

social science - the team of people involved in the scientific preparation of space food and the containers the food is stored in

reading - using the dictionary, encyclopedias, and other reference books for inquiry

spelling - spell such words as nutrition, astronaut, aerospace, aviation, vitamins, metabolism, and digestion

vocabulary - define words such as pressurization, gravity, aviation, medicine, and hypoxia

writing - creative recording a menu the child would choose for lunch while on the moon, or a space snack would be very nutritional

economics - the cost of space lunch and comparing that cost to a lunch at McDonalds

Summary

The ideas presented in this section are intended to serve as a springboard for educators to soar more deeply into theories behind how children learn. A few very basic theories of how children learn have been presented and discussed briefly. Each has been related to aerospace educational opportunities for the child. Educators better meet the needs of children when there is an understanding of how a child thinks and what the needs of specific age children include. The components in learning serve as a basic and general guide to educator of elementary age learners.

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